

Appln. No. 10/790,931
Response to Office Action mailed June 9, 2006

R E M A R K S

The amendments to claims 1, 11, 12 and 17 concerning the relationship between the carbon content and the chromium content is supported by the paragraph bridging pages 17 and 18; page 18, lines 11 and 12; and the first full paragraph on page 19 of the specification.

The amendment to claim 6 involving "a parent phase of a martensitic structure" is a feature recited in claim 1.

With respect of Rule 116, entry of the claim amendments is respectfully requested, since several of the claim amendments are in reply to a 35 USC 112 rejection set forth for the first time in the final rejection.

Claims 1, 7, 11, 12, 17 and 19 were rejected under 35 USC 112, second paragraph, for the reasons set forth in item nos. 2 to 5 on page 2 of the Office Action.

Claims 1, 7, 11, 12, 17 and 19 were amended hereinabove to avoid the 35 USC 112, second paragraph rejection. Withdrawal of the 35 USC 112, second paragraph rejection is therefore respectfully requested.

Claims 1, 3 to 15, 17 to 20 and 22 were provisionally rejected on the ground of obviousness-type double patenting as being unpatentable over claims 1 to 12, 17 to 20 and 22 of copending application Serial No. 10/790,959 for the reasons set forth in item no. 6 on pages 2 and 3 of the Office Action.

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Copending application Serial No. 10/790,959 is still being prosecuted. Therefore, until the above-identified application Serial No. 10/790,931 or application Serial No. 10/790,959 is deemed allowable, the double patenting rejection is premature.

Claims 1, 3 to 15, 17 to 20 and 22 were provisionally rejected on the ground of obviousness-type double patenting as being unpatentable over claims 1 to 17 of copending application Serial No. 11/234,959 or claims 1 to 20 of copending application Serial No. 11/235,425 for the reasons stated in item no. 7 on page 3 of the Office Action.

Application Serial No. 11/235,425 is a divisional application of the above-identified application Serial No. 10/790,931. Application Serial No. 11/235,425 was filed pursuant to a Restriction Requirement under 35 USC 121 in the parent application and thus should not have been included in the above double patenting rejection. Accordingly, it is respectfully requested that the double patenting rejection with respect to application Serial No. 11/235,425 be withdrawn.

Copending application Serial No. 11/234,959 is still being prosecuted. Therefore, until the above-identified application

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Serial No. 10/790,931 or application Serial No. 11/234,959 is deemed allowable, the double patenting rejection is premature.

Claims 1, 3 to 8 and 17 to 19 were rejected under 35 USC 102 as being anticipated by USP 3,663,314 to Monma et al. for the reasons indicated in item nos. 9 to 19 on pages 4 to 6 of the Office Action.

It was admitted in the June 9, 2006 Office Action that the Cr concentration in cementite at 2.5 to 10 wt% recited in applicants' claim 1 is not taught by Monma et al.

It was admitted in the June 9, 2006 Office Action that the pearlite or retained austenite, as recited in applicants' claims 4 and 5, respectively, are not taught by Monma et al.

It was admitted in the June 9, 2006 Office Action that a prior austenite grain size of ASTM 10 or higher recited in applicants' claim 6 is not taught by Monma et al.

It was admitted in the previous Office Action of December 8, 2005 that the prior art does not teach a quenched hardened layer containing 0.1 to 1.5 microns, as recited in applicants' claim 3.

A bearing steel according to Monma et al. is produced such that after the steel is entirely heated in a furnace, a member

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which has been thoroughly hardened by quenching is tempered. It is considered that based on the following steel composition disclosed in Monma et al. consisting of C: 0.55 to 0.78 wt%, Cr: 0.5 to 2.0 wt%, Mn: 1.00 to 2.00 wt% and Si: 1.0 to 2.0 wt%, that there is a high risk for distortion during quenching or quenching crack.

According to applicants' claims, only a surface layer of a rolling element is case-hardened by induction hardening. More specifically, applicants' present claims relate to a gear member in which a quench hardened layer is formed along a tooth profile. Monma et al. do not teach or suggest a steel composition suitable for induction hardening or a quench-hardened layer. Monma et al. also do not teach or suggest information relating to how to obtain a martensite structure (carbon concentration).

The following Table 1 shows sample compositions of Monma et al.

1. Alloy Nos. 27 to 32 and 35 to 37 have bearing steel compositions which fall within the compositions set forth in claim 1 of Monma et al.

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2. The carbon and the Cr contents in alloy Nos. 12 to 19 and 25 to 37 are within the ranges of carbon and Cr contents in claim 1 of applicants' present claims.

3. In the steel product of applicants' present claims, the Cr content depends on the carbon content in order to ensure that there is a Cr concentration range of 2.5 to 10 wt% in cementite. See the paragraph bridging pages 17 and 18 and the first full paragraph on page 20 of the present specification, in which a relationship between C (wt%) and Cr (wt%) is provided. For example, when the C content is 0.55 wt%, the Cr content is 0.3 wt% or more; and when the C content is 1.5 wt%, the Cr content is 1.8 wt% or less. Therefore, the following equation is satisfied in the steel product of the present claims:

$$0.55 \text{ wt\%} \times C \text{ wt\%} \leq \text{Cr content} \leq 1.2 \times C \text{ wt\%}$$

(Note: in the above formula, constant number 0.55 is obtained by $0.3/0.55$, and the constant number 1.2 is obtained by $1.8/1.5$).

It is clear that none of the alloy Nos. 12 to 19 or 25 to 37 of Monma et al. satisfies the above equation. Since Monma et al. do not teach the appropriate balance between carbon content and chromium content, there is a substantial distinction between applicants' present claims and Monma et al.

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Table 1

Alloy compositions in Monma et al. and (% Cr/%C) evaluation

| No. | C | Si | Mn | Cr | Cr/C≤1.2 |
|-------|------|------|------|------|----------|
| No.1 | 0.2 | 0.2 | 0.22 | 0.14 | 0.700 |
| No.2 | 0.38 | 0.23 | 0.26 | 0.12 | 0.318 |
| No.3 | 0.5 | 0.23 | 0.3 | 0.13 | 0.280 |
| No.4 | 0.61 | 0.22 | 0.29 | 0.12 | 0.197 |
| No.5 | 0.84 | 0.25 | 0.21 | 0.12 | 0.143 |
| No.6 | 0.22 | 0.25 | 0.3 | 0.14 | 0.638 |
| No.7 | 0.4 | 0.26 | 0.43 | 0.14 | 0.350 |
| No.8 | 0.44 | 0.2 | 0.34 | 0.14 | 0.318 |
| No.9 | 0.5 | 0.21 | 0.35 | 0.14 | 0.280 |
| No.10 | 0.6 | 0.26 | 0.44 | 0.14 | 0.233 |
| No.11 | 0.8 | 0.26 | 0.44 | 0.14 | 0.175 |
| No.12 | 0.45 | 0.33 | 0.39 | 1.44 | 3.200 |
| No.13 | 0.55 | 0.34 | 0.41 | 1.47 | 2.673 |
| No.14 | 0.65 | 0.36 | 0.38 | 1.48 | 2.231 |
| No.15 | 0.7 | 0.35 | 0.38 | 1.5 | 2.143 |
| No.16 | 0.78 | 0.35 | 0.38 | 1.5 | 1.923 |
| No.17 | 0.88 | 0.35 | 0.41 | 1.48 | 1.582 |
| No.18 | 0.95 | 0.33 | 0.39 | 1.45 | 1.525 |
| No.19 | 1.17 | 0.35 | 0.42 | 1.45 | 1.239 |
| No.20 | 0.44 | 0.2 | 0.34 | 0.14 | 0.318 |
| No.21 | 0.45 | 0.8 | 0.4 | 0.13 | 0.289 |
| No.22 | 0.46 | 0.04 | 0.38 | 0.12 | 0.267 |
| No.23 | 0.46 | 1.47 | 0.38 | 0.13 | 0.283 |
| No.24 | 0.44 | 1.83 | 0.3 | 0.14 | 0.318 |
| No.25 | 0.7 | 0.35 | 0.38 | 1.5 | 2.143 |
| No.26 | 0.71 | 0.88 | 0.41 | 1.44 | 2.028 |
| No.27 | 0.88 | 1 | 0.38 | 1.44 | 2.118 |
| No.28 | 0.69 | 1.2 | 0.39 | 1.46 | 2.118 |
| No.29 | 0.69 | 1.5 | 0.39 | 1.45 | 2.101 |
| No.30 | 0.7 | 1.67 | 0.4 | 1.45 | 2.071 |
| No.31 | 0.7 | 1.8 | 0.37 | 1.43 | 2.043 |
| No.32 | 0.71 | 1.99 | 0.3 | 1.46 | 2.058 |
| No.33 | 0.85 | 0.25 | 0.41 | 1.44 | 1.518 |
| No.34 | 0.78 | 0.22 | 0.37 | 1.46 | 1.872 |
| No.35 | 0.78 | 1.52 | 0.25 | 1.32 | 1.692 |
| No.36 | 0.65 | 1.63 | 0.89 | 1 | 1.538 |
| No.37 | 0.55 | 1.7 | 0.9 | 1.6 | 2.908 |

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Withdrawal of the 35 USC 102 rejection is thus respectfully requested.

Reconsideration is requested. Allowance is solicited.

If the Examiner has any comments, questions, objections or recommendations, the Examiner is invited to telephone the undersigned at the telephone number given below for prompt action.

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Respectfully submitted,



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Encs.: (1) PETITION FOR EXTENSION OF TIME
(2) NOTICE OF APPEAL